Anesthesia

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Name: _____

Subject: **Anesthesia**

ANAESTHESIA

ARVINDER SINGH

ARVINDERMOON SINGH


MBBSHELP.COM

OBJECTIVES OF ANAESTHESIA :-

1> For analgesia
2> Muscle Relaxation
3> Amnesia

⇒ TRIAD OF ANAESTHESIA

HISTORY OF ANAESTHESIA :-

1> Term Anaesthesia was coined by OLIVER WANDELL HOLMES

2> FATHER OF ANAESTHESIA - JOHN SNOW

3> FATHER OF MODERN " W. T. G MORTEN

4> O_2 & N_2O SYNTHESISED By PRIESTLY

5> N_2O → provides analgesia

6> This property Discovered by Humphrey Davy →

1st clinical Demonstration of N_2O anaesthesia was given by Horace Wells → he used N_2O as dental anaesthesia - 1844

7> Ether - Sweet Oil of vitriol

1st clinical demonstration was given by W. T. G. MORTEN on 16/10/1846.

↓

World Anaesthesia Day

8> Cocaine → 1st local anaesthesia.

also shows vasoconstriction.

Nowadays, ~~used~~ 4% sol^n is used as topical anaesthesia for eye

It can cause addiction.

9> 1st Spinal Anaesthesia was given by AUGUST BIER

Cocaine was the 1st drug to be used for spinal anaesthesia

10> Curare-

Harold Griffith was the 1st person to use curare ~~use~~ for Muscle Relaxation

11> 1st E.T. Intubation was done by William Mecwen & was made popular by Evan Magill.

ASA GRADING (American Society of Anaesthesiologist)

It determines physical status of patient

Although commonly used for Risk Assesment ; it is not ~~indeed~~ intended to be used for assessment of Risk.

(I) - (N) Healthy Pt
No Systemic Disease
Minimal or NO alcohol Intake
Pt is a non smoker

(II) - Pt. c mild systemic Disease c is well controlled
c no functional Limitation.
eg. well controlled DM , HTN
Pts c BMI of 30-40
♀
Pts c mild lung Disease
Current smoker
Social Drinker

(III) - Pt. c severe Systemic Disease c functional Limitation.

eg. - uncontrolled DM & HTN
- Pt BMI >40
- Alcohol Dependence
- EF (40-45%) [Mod. Reduc^{n} of EF]
- Pt. c end stage Renal Disease on regular dialysis.
- > 3 months H/o - MI/ CVA/ TIA/ stents.

(IV) - Severe Systemic Disease c is a constant threat to life of patient

eg. - unstable angina
- < 3month H/o - MI/ CVA/ TIA/ stents
- ARDS
- End stage Renal Disease on irregular dialysis.
- Severe Reduc^{n} of EF.

(V) - Moribound Pt. who is unlikely to survive c out S_x

Rupture thoracic or abdominal aneurysm
Massive intracranial bleed c midline shift
Massive trauma

(VI) - Brain dead pts. - for organ donation

If any of the pt come in emergency, (E) is written before ASA Grading

DRAWBACK of ASA Grading :-
surgical risks are not covered

MALLAMPATI GRADING

M/C airway examⁿ done ☆
It is used to asses size of tongue for laryngoscopy

(I) - Facial Pillars
Uvula ī Tip
Soft palate

(II) - Uvula ī out tip
Soft palate

(III) - only soft palate
(IV) - only hard palate
→ Difficult Intubations.

OTHER TESTS

1> Thyromental Distance = Dist Betⁿ Mentum • Thyroid
should be → > 6.5cm

2> Sternomental Distance - > 12.5 cm [mentum → sternum]

3> Adequate Mouth opening
Gap Betⁿ upper & Lower Incisors
should be → > 3 fingers breadth or 2cm

4) Movement of cervical spine

Difficult in ankylosing spondylitis pt.

MANAGEMENT OF PRE-EXISTING DRUG THERAPY

I> MAO Inhibitors -

Older MAOI should be stopped 3 wks before surgery.

They cause sev. sympathetic Rxn i Pethidine

Newer MAOI SELEGILINE can be continued uptil 1 day before surgery

II> LEVODOPA -

Continued

III> ANTICONVULSANTS -

should be continued

Morning dose to be given

IV> OHD / Insulin -

Morning Dose of is omitted becoz pt is fasting.

Ideal Fasting Period.

Adults → Solid - 6hrs

Clear liquid - 4hrs.

Breast feeding Infant - Solid - 4hrs

Clear liquid - 2hrs

If infant is on formula feed or non-human milk → then it should be 6hours

For Major Sx,
Pt is shifted from OHD to Insulin (48hrs) before Sx.

VI) ORAL ANTICOAGULANTS / WARFARIN - Q

INR - 2-3

Stopped 4-5 days before Sx

For Sx INR should be <1.5

For emergency Sx, Vit K / FFP can be used.

For LMWH,
Last Dose - 12-14 hrs before Sx

For unfractioned Heparin, uptil 6hrs before Sx

VII) OCPs -
Should be stopped 4 weeks before Sx
Only Progesterone pill can be continued

(VIII) Anti-HTN - Q
All Anti HTN should be continued if possible
exception of ACEI / ARB
↓
can cause Refractory hypotension during anaesthesia

β blockers are preferred agents to ↓ peri operative mortality

VIII) Anti- Anginal -
~~Nco~~ continued

IX) Thyroid Drugs -
continued

X) LITHIUM - Q
should be stopped 2 days before Sx
It prolongs non. depolarising m/s relaxants.

XI) STEROIDS- Q
should be continued, morning dose to be given.

Steroid intake suppresses endogeneous cortisol. If it is withdrawn before Sx, there may be refractory hypotension.

XII) SMOKING- Q
should ideally be stopped 6-8 weeks before Sx

In smokers - mucociliary ~~clearance~~ movement is inhibited
↓
So clearance is impaired.

If stopped 12-24 hrs
↓
↓ CO-Hb level
↓
will shift O_2-Hb dissociation to Right.

Smoking also ↓ surfactant level. & also potency of aminosteroid m/s relaxants.

XIII) ANTI-PLATELET DRUGS Q

1) ASPIRIN-

Low Dose (75mg)
↓
should be contenued
except for closed space surgeries

eg. Sx of Brain, spinal cord & Eye

>75mg
↓
should be stopped 3-5 days before Sx

2) CLOPIDOGREL-
should be stopped 7 days before Sx

3) TICLOPIDINE- Q.
should be stopped 14 days before Sx

XIV) HERBAL MEDICATIONS-
should be stopped 6-8 wks before Sx

XV) STATINS-
should be continued

PRE-MEDICATION

AIMS -

1> To ↓ anxiety ⇒ Longer acting BZD - LORAZEPAM
For Day-care Sx -
Midazolam
Temazepam

2>

2> Provide sedation + amnesia

3> Promote hemodynamic stability

4> To ↓ aspiration.
Gastric juice - PPI + H_2 blockers

Aspiration in ♀ = MENDELSON SYNDROME
↙ ↘
pH < 2.5 Vol. > 25mL

5> To provide analgesia
Morphine or Pethidine can be used
↓
Shouldn't be used in renal failure pt.
As its metabolite Nor-pethidine accumulate + can cause convulsions

6> To Prevent Post-Op Nausea + vomiting
- Ondansetron + Metoclopramide
↓
Main S/E = Headache

7) To control Infection
Broad spectrum Antibiotics
1st Dose → upto 1 hour before skin incision
If Sx prolongs for > 6 hours ⇒ Antibiotic dose should be repeated

8) To control oral secretions
Atropine or Glycopyrolate

ANAESTHESIA MACHINE (A.M.)

1st used in 1917.
Also known as EDMUND GASKIN BOYLE Anaesthesia machine
continuous flow- type of anaesthesia machine
↓
fresh gas flow both during Inspiration & expiration

A.M.

HIGH PRESSURE SYSTEM	INTERMEDIATE PRESSURE SYSTEM	LOW PRESSURE SYSTEM
- Cylinders	- Flow control valve	Rotameter
- Yolk Assembly	- O_2 + N_2O Proportionating devices	Vapouriser
- Pressure Gauge	- O_2 flush	Common Gas outlet
- Pressure Reducing Valve	- Central supply Lines	

HIGH PRESSURE SYSTEM

1> CYLINDERS

Made up of special alloy - Mb Steel

In MRI room, cylinders are made of Aluminium

Size of cylinder - A to H
↓ Smallest ↓ Largest

Cylinder M/c by used = E.
↓ Contain 660 L of O_2

Type D - contains 470 L of O_2.

COLOUR CODIND OF CYLINDER

O_2 → Black Body & White Shoulder

N_2O → Blue

CO_2 → Grey

Cyclopropane - Orange

Helium - Brown

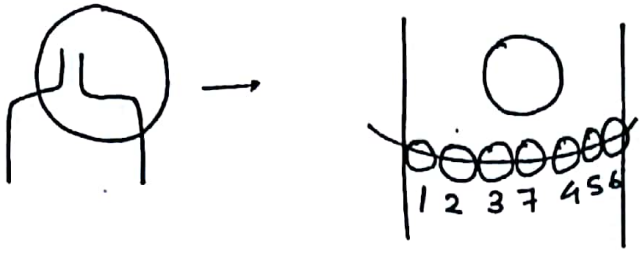
Entonox - ~~50%~~ 50% O_2 + 50% N_2O
Blue Body & Blue + White Shoulder

If O_2 is replaced by N_2O ⇒ Hypoxia occurs

M/c type of hypoxia during anaesthesia = Hypoxic Hypoxia

PIN - INDEX SYSTEM

It prevents wrong fitting of anaesthesia cylinders



O_2 = 2, 5

N_2O = 3, 5

CO_2 = 2, 6

cyclopropane : 3, 6

to.
Entonox = 7

Pin. Index no. can fail if wrong gas ~~can~~ is filled inside cylinder &

* pins of Pin Index System ~~can~~ are damaged.

TARE WEIGHT -
wt. of empty cylinder.

FILLING RATIO -
Ratio of $\frac{\text{\% of wt. of gas}}{\text{wt. of water cylinder can hold at } 60^\circ F}$

It prevents overfilling of cylinder

WOOD'S METAL

→ Alloy of low melting Point ∴ is present between the cylinder wall & Body

→ In case of fire, this melts & forms a small gap through ∴ leakage of gas occurs.

N_2O, CO_2, cyclopropane are stored in cylinders in liquid form.

O_2 can also be stored in liq. form.

Critical Temp. for O_2 = −119°c.

Each 1mL of liq O_2 gives 840 mL of gas

Critical Temp for N_2O is 36.5°c

2> **YOLK ASSEMBLY**

It attaches cylinder into anaesthesia machine

Pins of Pin Index System are part of Yolk Assembly

3> **PRESSURE GAUZE**

It measures pressure inside cylinder

Most commonly used is Bourdons ~~P~~ Pressure Gauge

↓

It works well ∵ O_2 as it is stored in gaseous form

In Liq gases, even if amount of is ↓ Pressure remains same until it finishes completely → then becomes zero

So, tare wt. is Imp in case of liq gases.

4) **PRESSURE REDUCING VALVE**

O_2 = 2000 psig
N_2O = 750 psig
Cyclopropane = 600 psig. } → May cause BAROTRAUMA

Pressure Reducing valve ↓ this pressure to 35-45 psig

Cyclopropane doesn't req. Pressure Reducing valve

1 atm = **14.6 psi**

INTERMEDIATE PRESSURE SYSTEM

1> **FLOW CONTROL VALVES**

To control flow rate of gases

O_2 - White in colour
Bigger ∴ Broader serrations

N_2O - Blue in colour
Smaller ∴ Finer serrations

2> **O_2-N_2O PROPORTIONATING DEVICES**

⇒ In Earlier machines, initially 100% O_2 then 100% N_2O
↓
[Risk of Hypoxia].

⑥ ⇒ Master : Slave Device-
N_2O is delivered when O_2 is switched off

⇒ O_2 + N_2O proportionating Device-
The devices provide fixed % of total flow as O_2
The min. % of O_2 delivered by these are 25%.

O_2 Req. during Gen. Anaesthesia = 30%

3> **O_2 FLUSH**

It delivers emergency O_2 @ 35-75 L/min

4> **CENTRAL SUPPLY LINE**

Made up of copper.
Central lines are colour coded

O_2 = White
N_2O = Blue
Air = Black
Suction/Vacuum = Yellow

They also have safety Mechanism
↓
DISS (Diameter Index Safety System)
↳ t consists of non-interchangeable different diameter screws for O_2 & N_2O.
Pressure Inside Central Supply Line = 45-55 psig

LOW PRESSURE SYSTEM

ROTAMETER

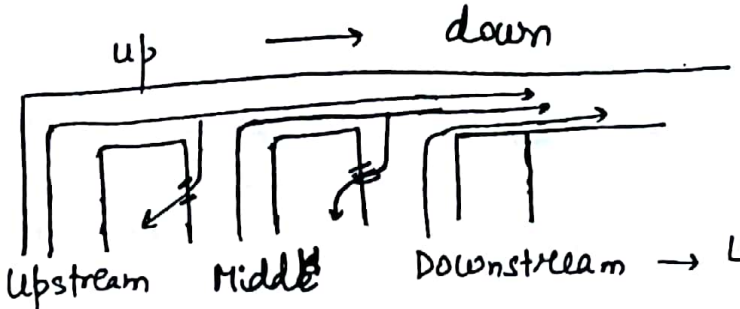
→ It consists of Glass Tubes known as Thorpe's Tube
→ Made up of special Glass → K/n/a PYREX GLASS
→ Glass tubes are caliberated according to the Gase they carry.
→ These Glass tubes have variable orifice but constant Pressure
→ These Glass tubes contain an indicator for gas flow → Bobbin
↓
Made up of Aluminium

← upper part denotes gas flow

3L

CAUSES OF INACCURATE READING OF FLOW METER :-

1) Dirt
2) Static electricity
3) Vertical alignment
4) Cracked Glass tubes
5) Back flow of gases



→ Less chance of hypoxia

O_2 should always be downstream to all other gases

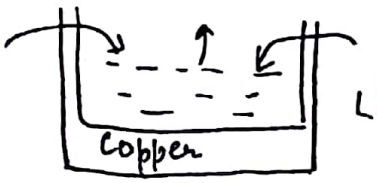
VAPOURISERS

→ used to provide Inhalational Agents like
Halothane
Desflurane
Sevoflurane etc to the pt.

→ Most Imp. Property on ∝ delivery of agent depend is Vapour Pressure of agent.

→ Vapourisers are made of Copper
↓
Good Thermal Conductivity, Specific heat.

→ Vapourisers are Temp. & Pressure Compensated.
⇓
Any change in temp. & pressure doesn't affect delivery of agent

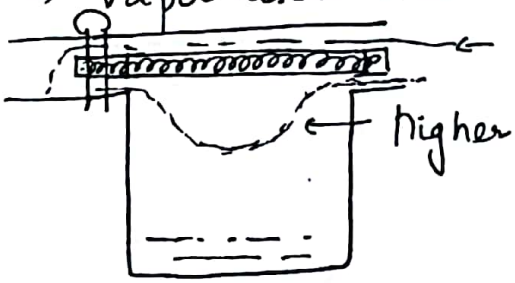


Latent heat of vapourisation released.
↓
Temp. reduces.

} Copper transfer Atmospheric temp to maintain

→ At higher altitude, vapourisers deliver higher O_2 to maintain same partial pressure

→ Vapouriser are Variable Bypass vapouriser



→ Higher the amount of O_2-N_2O passes through vapouriser
↳ higher the conc" of gas.

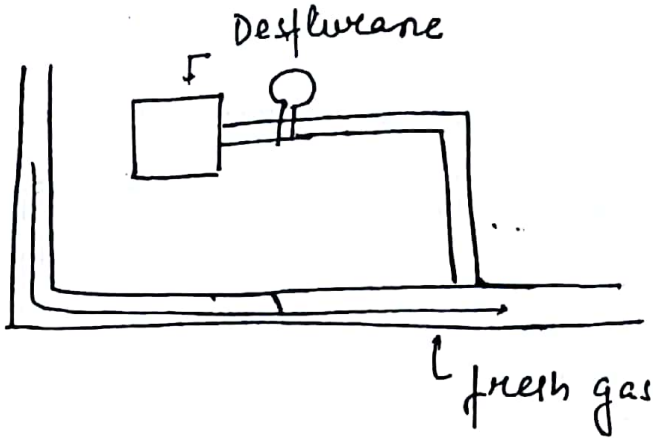
→ Only exception to variable Bypass
↳ Vapouriser of DESFLURANE
↓
Tec-6 vapouriser.

* Desflurane
↳ ↑ B.P. = 23°c
↳ ↑ vapour Pressure

→ Desflurane vapouriser is heated to a temp. of 39°c to achieve this ↑ vapour pressure.

→ To give it in clinical conc", 60-70 Litres of fresh gas is required. ∴ is not possible by variable Bypass vapouriser (6-7L)

→ Vapours of Desflurane are directly injected into the fresh gas flow



Desflurane is directly injected into fresh gas flow.

COLOUR CODING OF VAPOURISER-

Halothane - Red

Isoflurane - Purple

Desflurane - Blue

Sevoflurane - Yellow

All gases come out through common gas outlet.
A Circuit is attached to the common gas outlet

Wheels of Anaesthesia Machine are made Antistatic by addition of Carbon

O_2 CONCENTRATORS

Consist of ~~Ze~~ ZEOLITE & $Al(OH)_3$ Lattice

- absorbs N_2 from air. ⇒ only O_2 will be left
- Provide 95% O_2 not 100%
- Electronically powered
- Rest 5% ~~are~~ - Argon & is inert gas.

O_2 ANALYSER

It measures O_2 leaving the machine
It is usually put upon Inspiratory limb of circuit.

CIRCUITS

They are connecton bet' the anaesthesia machine & the patient.
They provide oxygenation, ventilation.

3 types

1) OPEN CIRCUIT

It consists of a mask → Schimmelbusch mask.
Method is kpha → Open drop method
Agents used are ether, chloroform.

ADVANTAGE
- Easy to use

DIS →
- Cannot control conc" pt inhales
- Theatre pollution
- When pt becomes unconscious, pt. may hypoventilate leading to hypoxia

2) SEMI-OPEN / SEMI CLOSED SYSTEM.

M/c ly used is ~~MABE~~ MAPLESON SYSTEM

6 types

(A) MAPLESUM A

↳ MAGILL CIRCUIT.

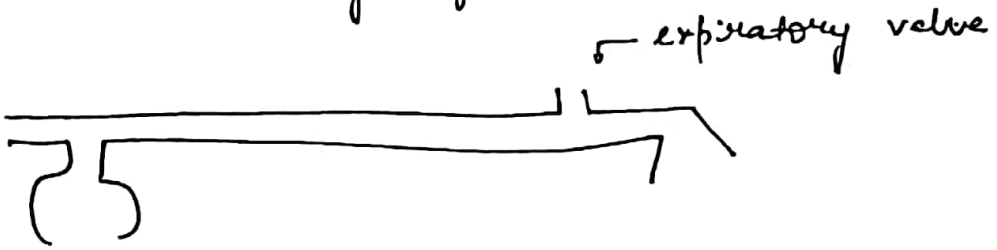
→ Best for spontaneous ventilation.

→ Fresh Gas flow required to prevent Re-Breathing = Minute vol. of Patient

Q. Minute vol = Tidal vol. x R.R.

500 mL x 14 = 7L

T.V. = 7 mL /kg Body wt



Modification of Maplesum A = LACK circuit

↓

Coaxial circuit.

Outer tube = Inspiratory

Inner " = Expiratory

(B) obselete

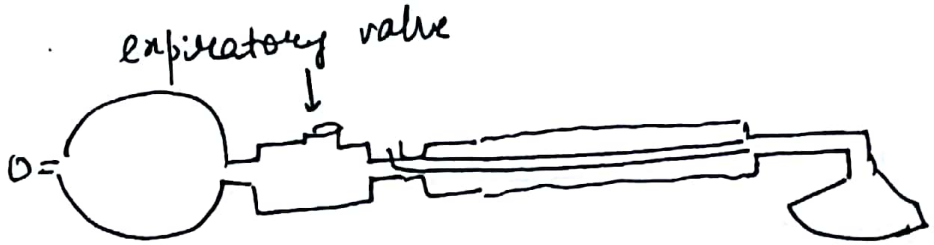
(C) also k/n/c = waters to * fro circuit.

used for transportation & Resuscitation.

(D) also k/n/a = Bain circuit

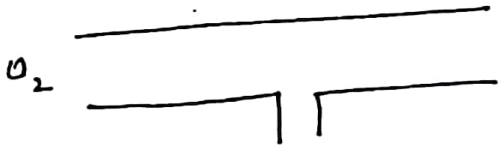
Best for controlled Ventilation

Fresh Gas Flow req = 1.6 x minute vol. of pt.



Coaxial Circuit
outer = expiratory
Inner = Inspiratory

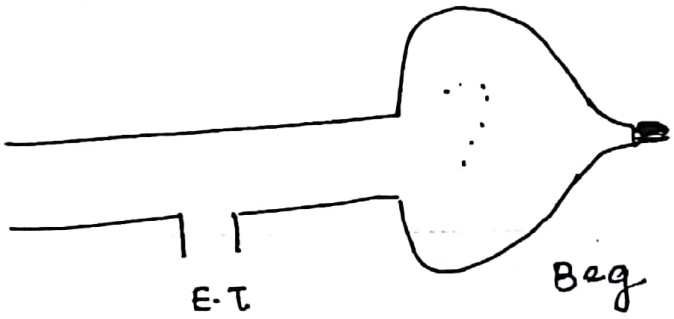
(E) also k/h/a - AYRE'S T PIECE



used in spontaneously Breathing pt
Neonates

No valve tht, no Breathing Bag

(F)



JACKSON. REES MODIFICATION of AYRE's T PIECE

used in children < 6yrs. or < 20 kg

Both (E) & (F) are valveless circuit
Do not contain any valves

3> CLOSED CIRCUIT

$O_2 + N_2O$ + Inhalational Agent → $O_2 + N_2O$ + I:A.

+

CO_2

← Inspired Gas → ← Expired Gas →

If CO_2 removed → gases can be reused

SODALIME

Gases passed through sodalime

It absorbs CO_2

Leading to ↓ req. of fresh Gas flow.

It consists of $Ca(OH)_2$ - 94%

NaOH - 5% as Catalyst

KOH = 1% as activator

Silica for Hardness.

Each 100 gm of sodalime absorbs 23-26 L of CO_2.

Indicator is added ∴ Changes colour of ✱ Sodalime

Ethyl violet → White to violet

Phenophthalin → white to pink

Clayton yellow → Red to yellow

Mimosa 2 → Red to white

SIZE of granules = 4-8 mesh size in Sodalime

C/I -

1) TRILENE

It reacts ē trielene to form Dichloroacetylene
↓
neurotoxic or
phosgene → ARDS

Alternative to Sodalime — BERYLIME
↓
$Ca(OH)_2$ – 80%
$Ba(OH)_2$ – 20%

This mix. is less caustic & hardness occurs due to H_2O of crystallization.

Beryleme causes higher incidence of airway fire, ∴ less commonly used

* Management of airway fire.

→ It occurs most commonly during <u>vocal cord Injury ē Laser</u>

<u>STEPS</u>

1) stop ventilation & remove tracheal tube
2) Turn off O_2, disconnect circuit from anaesthesia machine
3) ~~Ver~~ Submerge tube in water
4) Ventilate ē 100% O_2 & re-intubate
5) Perform fibre optic Bronchoscopy & assess airway damage

6) Bronchodilators, steroids, Antibiotics if indicated.

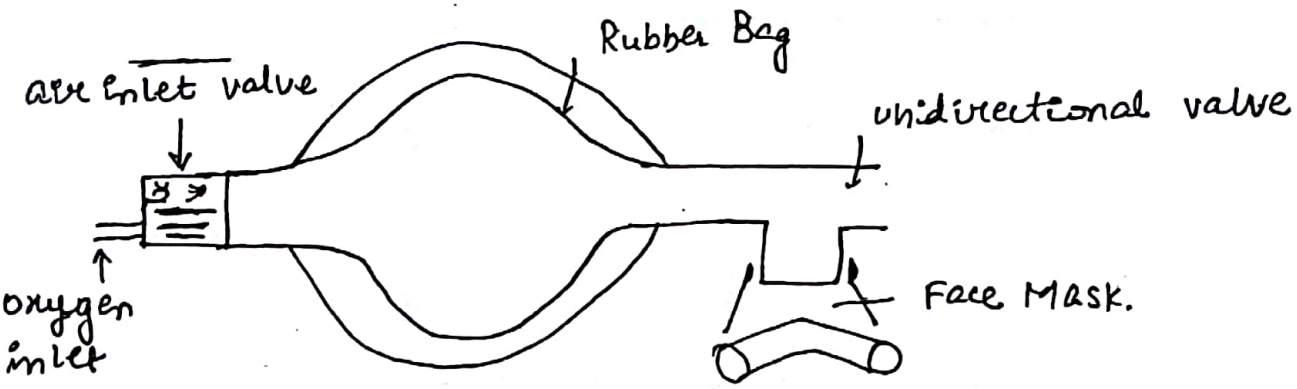
The closed circuit is Best, for maintaining Depth of Anaesthesia.

2) Removal of Expired Gas

3) Humidifaction.

EQUIPMENTS IN ANAESTHESIA

1) AMBU (Artificial Mannual Breathing Unit)



Max. % of O_2 that can be delivered by AMBU Bag = 100%.

It comes in various sizes

Neonate - 250 mL

Children - 500mL

Adults - 1-2L

2) FACE MASK

- It is used to provide seal for Positive Pressure Ventilation.
- made up of Anti-Static Rubber

- Comes in different size

3) GUEDEL'S OROPHARYNGEAL AIRWAY

→ prevents fall of tongue during anaesthesia

→ Correct size depends upon Dist. Bet^n Angle of Mouth & Tragus

4) NASOPHARYNGEAL AIRWAY

→ Prevents fall of tongue

→ Correct size depends upon Distance Between tip of NOSE & Tragus

5) LMA (Laryngeal Mask Airway)

→ Supraglottic Devices

→ They are not definitive airway

→ ADVANTAGE

- Easy to insert
- They do not require laryngoscopy or M/s Relaxation
- Can be used for difficult airway & CPR

Size of LMA depend upon wt. of pt

1-5 Kg → 1

5-10 kg - 1.5

10-20 kg - 2

20-30 kg - 2.5

30-50 kg → 3 → In children
50-70 kg → 4 → In adult
70-100 kg → 5
>100 kg → 6

Largest possible size of LMA should be inserted as it forms Better oropharyngeal seal.

Disadvantage
Higher incidence of sore throat

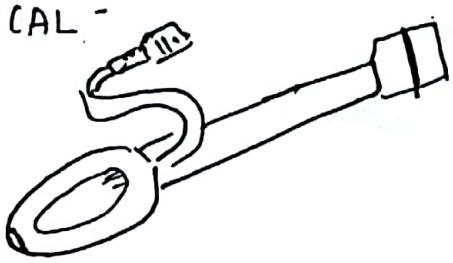
C/I of LMA.
1) full stomach pt. eg
TEF
Recent meal

2) Pts having low pulmonary compliance
eg. morbidly obese pts.

3) Pts ⊂ oral pathologies
eg. Pharyngeal abscess
Ludwig angina
Inadequate ~~mo~~/small mouth opening

TYPES

1) CLASSICAL -



can be autoclaved upto 40 times

Tip of LMA corresponds to oesophagus

2) FLEXOMETALLIC LMA -

Tube doesn't kink

3) FAST TRAC LMA / INTUBATING LMA -

Designed for difficult intubation

4) PROSEAL LMA.

Designed for PPV

Any ↑ in gastric pressure → comes out through drain tube

Disposable proseal LMA = Supreme LMA

DEAD SPACE

Decreasing Order ⟶

Face Mask > LMA > Endotracheal tube > Tracheostomy

6> LARYNGOSCOPE -

→ M/cly used - Macintosh Blade

→ Straight → MILLER BLADE

→ Laryngoscope should always be held in (L) Hand

→ Inserted from (R) side of mouth.

→ Tongue deviated to (L) side

→ Laryngoscope blade should never be levered upon upper Incisors

→ Position of Laryngoscopy -
Extension @ atlanto-occipital Jt. + Flexion in neck. → sniffing position

⇓

It brings oral, laryngeal, pharyngeal axis in a straight line

→ M/c structures Damaged during Laryngoscopy
↳ upper Incisors

→ STRESS RESPONSE TO LARYNGOSCOPY
↳ Sympathetic response
HTN, Tachycardia, Arrhythmia

→ Response can be ↓ by → β blockers
→ Opoids
→ Deepening anaesthesia c volatile agents
→ Lignocaine

7) ENDOTRACHEAL INTUBATION

2 most commonly used Tubes

RED RUBBER TUBE	PVC TUBE
1) Reusable	1) Disposable
2) Expensive	2) Cheap
3) Higher tendency to kink	3) Less tendency to kink
4) MURPHY EYE ⊖	4) Murphy eye +nt
5) Cuff → High Pressure Low Volume	5) Cuff → High volume Low pressure
Due to high pressure, ↑ chances of tracheal injury	↓ chances of tracheal injur
6) used for shorter duration	6) used for longer duration
7) Non-transparent	7) Transparent
8) Radiolucent	8) Radio-opaque
9) They have lower incidence of sore throat	9) ↑ incidence of sore throat

MURPHY'S EYES →

- When tube get blocked, through murphy's eye ventilation can be continued
- small hole is present in lateral wall of tube to prevent blockage.

M/c size of tube used for adult ♂ = 8, 8.5

♀ = 7, 7.5

Length of tube ± comes at upper incisor =

♂ 21-22 cm

♀ - 20-21 cm

Cuff of tube should lie in upper trachea 2-2.5 cm below vocal ~~to~~ cords

Cuff pressure should never exceed 30 cm of H_2O

If > 30 cm H_2O → Tracheal Mucosal necrosis

H/c of vocal cord Paralysis → Compression of ant. Br. of Recurrent laryngeal n/v

↓

C is compressed by cuff of tube

CONFIRMATION OF TUBE IN TRACHEA

1) ↑ - ↓ of chest.

2) Fogging of tube → seen in PVC tube

3) CXR → seen in PVC tube

4) Auscultation.

RA LA

RB LB → Most Imp. area for auscultation.

Breath sound confirms tube is above carina

GOLDEN STD FOR INTUBATION

↓

CAPNOGRAPHY

↓

$ETCO_2$ → 35-45 mm of Hg

EU - Exp. upstroke
EP - Exp. plateau
ID - Insp. downstroke

* FLAT CAPNOGRAM–

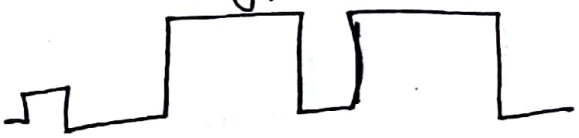
1) Disconnect of circuit
2) Incidental extubation
3) Ventilatory failure
4) Oesophageal Intubation
5) Cardiac arrest

* Sudden ↓ in $ETCO_2$ -

1) Venous air embolism
   ↳ occurs M/c/ly in Sitting Position for Post. fossa surgeries
   Most lethal complication of sitting position

* SUDDEN ↑ in $ETCO_2$ -

1) Malignant Hyperthermia



2) Bronchospasm

SHARK - FIN APPEARANCE.

→ 

CURARE NOTCH

. Notch shows requirement of M/s relaxant during anaesthesia

→ 

EXP. VALVE LEAK

→ 

when there is CO_2 in inspiration

Hypoventilation

SPECIAL TYPE OF ENDOTRACHEAL TUBE -

1) RAE tube [® angled Endotracheal Tube]

→ These tube have preformed shape & are used for cleft lip & cleft palate Sx

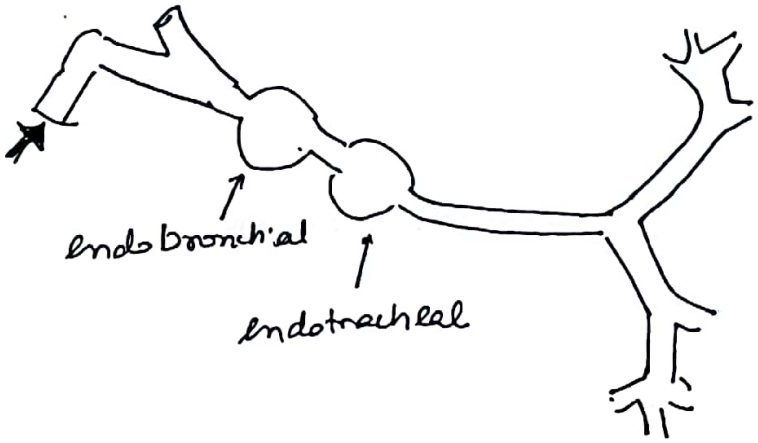
2) FLEXOMETALLIC TUBE/ SPIRAL EMBEDDED TUBE

→ Do not kink

→ used for . Head & Neck Sx in prone position
. Spine Sx

3) DOUBLE LUMEN TUBE

Used for Single Lung or 1 Lung ventilation.



1 lung can be ventelated by this

In single Lung ventilation = shunt fraction = 50%.

If shunt fraction >50% ⇒ HYPOXIA

Final position of double Lumen Tube is confirmed by fibre optic Bronchoscopy

M/c cause of Hypoxia during single lung ventelation ↑ shunt fraction.

E.T. In CHILDREN

→ uncuffed tube are used ≤ 6yrs

→ Minimal permissible Leak is allowed

→ Leak should be audible

→ If Leak is ↑ Bellow's of ventilator may collapse

↓

Mx

change the tube to a bigger size

Flow Rate $\propto r^4$

Small ↓ in airway causes large ↓ in flowrate.
So uncuffed tube used

⇒ SIZE of TUBE in children depends upon Age of child

Premature	2.5-3
Neonate	3-3.5
Infant	3.5-4
1-3 yrs	4-4.5
3-8 yrs	4.5-5.5
8-12 yrs	5.5-6] — cuffed tube

• No. of tube → Internal diameter 'd' in mm

⇒ Length of tube, $L = \frac{\text{Age (yrs)}}{2} + 12\text{cm}$

NASOTRACHEAL INTUBATION

INDICATIONS-

1) # Mandible
2) Oral Sx
3) Inadequate mouth opening
4) awake fibreoptic Intubation.
5) If tube is to be kept for longer time

C/I :-

1) # Base of skull
2) CSF Rhinorrhoea
3) Nasal mass →
4) Adenoids
5) Coagulopathy
   eg. hemophilia
   platelet disorder

Other Features :-

1) ↓ movement of E.T.
2) good oral hygiene
3) Infection rate of 15-20%
4) Nasal mucosal Damage

C/I to (B) NASAL , ORAL INTUBATION

1) Sev Laryngeal oedema
2) Sev. Epiglottitis
3) Laryngotracheobronchitis

⇓

Tracheostomy should be done in these cases

DIFFICULT AIRWAY ALGORITHM

PLAN (A) → (N) Laryngoscopy + Intubation → Successful

↓

Fail

↓

PLAN (B) → use of assisted ~~Device~~ Device

↓

LMA / LMA → confirm c Fibreoptic Bronchoscope

↓

Fail

↓

PLAN (C)

Maintain O_2 saturation

Bag, Mask ventilation → AIM: make pt. conscious, postpone Sx

↓

Fail

↓

PLAN (D)

Retry LMA → Needle cricothyrotomy

ventilation used is HFJV

(High frequency Jet Ventilation)

↓

~~to~~ Tracheostomy

I.V. ANAESTHETIC AGENTS

BARBITURATES

Thiopentone
Methohexitol

NON-BARBITURATES

- BZD
- Etomidate
- Ketamine
- Propofol

All these drugs ~~except~~ act upon GABA except ketamine

↓

NMDA (R)

↓

Xenon, N_2O } also act upon NMDA

STEROIDAL ANAESTHETIC

1) Althesin
2) Eltanolone
3) Propanidid

⇒ cause ↑ incidence of allergic Rxn
So withdrawn

MAX ALLERGIC Rxn

M/S Relaxant > Latex Products > Antibiotic

Potency of Anaesthetic Agent α Lipid Solubility

17 THIOPENTONE

→ Used 1st Time in 1934

→ Yellow amorphous powder & contains 6% anhydrous Sodium carbonate

→ Prepared, stored in N_2 atmosphere as it reacts & atmospheric CO_2 & precipitates

→ pH - 10.5
Highly alkaline
Shouldn't be mixed & RL
Can be mixed & → NS
5% Dextrose.
Distilled water

→ DOSE - 3-5 mg/kg Body wt
Adequate Dose → Loss of Eyelash Reflex

→ Conc^n = 2.5%
>2.5% causes ⇒ Pain of Injec^n
+
Venous Thrombosis

<2.5% causes ⇒ Awareness during anaesthesia

BISPECTRAL INDEX

→ Type of Frontal EEG
→ Used to detect awareness / depth of anaesthesia

For Adequate sedation, BIS value = 65 - 85

Adequate anaesthesia → 40 - 65

Cortical depression → <40

ONSET of thiopentone - 30 sec

Last for 15 - 20 min.

Pt Regains consciousness by thiopentone by Redistribution from

½ life of thiopentone = 10 - 12 hrs

Thiopentone contains sulphur atom

↓

c markedly ↑ Lipid Solubility

It is metabolised in Liver (Hepatic Oxidation)

It is a microsomal enzyme Inducer

SYSTEMIC EFFECTS

1> CVS → Peripheral vasodilatation

↓ venous return

↓

↓ BP

↓

↑ HR

Thiopentone cause Hypotension & Tachycardia

Tachycardia also occurs due to central vagolytic action

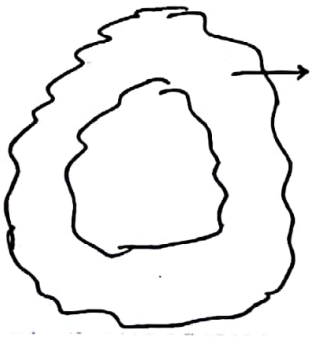
2) Resp- a) causes Resp. depression
↓
Apnea
↓
Rx = IPPV ± Bag + Mask

3) b) Histamine Release-
∴ Pt shouldn't be used in Asthmatic pt

c) may cause Reflex Bronchospasm, Laryngospasm

3> CNS a) potent cerebral vasoconstrictor
ICP ↓
DOC for Head Injury Pts

b) also markedly ↓ cerebral Metabolic Rate
∴ provide cerebral protection



c) Potent anticonvulsant
DOC for epilepsy pts

4> Anti-analgesic
↳ Lowers threshold for Pain.

5> Poor M/s Relaxant

6> Crosses Placenta → Fetal Depression

7) May show Anti-thyroid Action.

C/I For Thiopentone

1) Acute Intermittent Porphyria
   Variegate Porphyria
   can be safely used in Porphyria Cutanea Tarda
   * Other drugs ppt. Porphyria -
     Etomidate
     Pentazocine
     Ketamine (rats)

   Doc for Porphyria pt → PROPOFOL

2) Accidental Intra-arterial Inje" o-
   It occurs most commonly in anticubetal fossa
   Thiopentone ppts in arterial blood
   ↓
   Causes intense vasospasm of artery

   C/F → Pt complains of
   Sharp severe pain
   Loss of distal Pulse
   whiteness + Blanching of hands

   Mx - 1) Do not remove the needle
   2) Flush c NS
   3) Vasodilatons → Lignocaine
   4) Heparin to prevent thrombosis
   5) Stellate ganglion block. for

Brachial plexus block for peripheral (~~ut~~) vasodilatation (upper Limb)

2> METHOHEXITOL

1> ~~Protecting~~ Short acting

2) Cardio stable

3) may cause convulsions in small doses

4) DOC for ECT QQ

BZD

→ Not used as Induction Agents.

→ But as ~~cold~~ co-Induc" agents to ↓ dose of main induction agents

→ BZDs act upon **cerebral cortex** unlike other agents ∴ act upon Reticular Activating system

→ BZDs ↑ Cl^- ion Conductance

M/c ly used BZD

DIAZEPAM
oil Based
Propylene glycol
Pain on Inj"
IV/IM

MIDAZOLAM
water soluble
Short acting
IV/IM / Intranasal
orally

SYSTEMIC EFFECTS

1) CVS → ↓ BP
↓ Syst. vascular Resistance
↑ HR

2) Resp. → resp. depression
Specially given along ± opoids

3) CNS → ↓ ICP
↓ Metabolic Rate
Provide anterograde amnesia
anxidytic
anticonvulsants
Midazolam is 1st Line of drug for convulsions

4) Provide M/s relaxation @ Spinal cord Level ?

ETOMIDATE

→ Lipophillic
→ Rapid onset of action
→ Causes Pain on Injecn
→ Doesn't cause histamine Release
→ Most Cardiovascular stable agent
DOC → severe cardiovascular or cerebrovascular disease

→ causes highest incidence of nausea & vomiting

→ causes " " of myoclonic activity

→ causes adrenocortical suppression + inhibit steroid synthesis

↓

↑ mortality

→ Vit C supplement can prevent adrenocortical suppression.

KETAMINE

→ Causes dissociative anaesthesia

↓

Dissociation of Thalamic from Limbic system

Pt. apparently remains conscious but unresponding

→ Phencyclidine derivative

All Hallucinations & delirium seen c Ketamine are due to phencyclidine

→ Ketamine —Metabolised→ Nor-Ketamine

↓

anaesthetic potency

SYSTEMIC EFFECTS

1> CVS – Sympathetic stimulation.

↑ BP . ↑ HR

DOC for acute hypovolemic shock pts.

↑ myocardial O_2 demand
∴ C/I → HTN.
IHD,
Aneurysm pts

2> Resp- minimal resp. depression
maintains upper airway reflexes
↳ Doc for full stomach pts.
↳ Potent Bronchodilator
Doc for asthmatic pts
causes marked ↑ in oral secretions
∴ always given ī glycopyrrolate

3> CNS - potent cerebral vasodilator.
ICP ↑ & ↑ metabolic rate
C/I in space occupying lesions
Head injury
Epilepsy pts
causes Hallucinations
ē occurs more commonly in young pts
auditory > visual hallucination
Hallucinations can be ↓ by BZDs

4> ↑ IOP → ∴ C/I in Glaucoma pts.

USES

1) Short surgical procedure
2) Asthetic procedure
3) Burn dressings
4) For field anaesthesia

Ketamine is considered close to complete anaesthetic agent.

PROPOFOL

also k/n/a - 2,6 Diisopropyl phenol

→ Milky white liquid & comes as 1 & 2% emulsion

- contains- Soyabean oil, Glycerol, egg Lecithin } good culture medium for bacterial growth

→ Open propofol vial is discarded after 6hrs

- causes pain on Injection & can be ↓ by mixing Lignocaine in propofol.

→ Associated & quick recovery
↳ DOC for Day Care Sx.

→ DOC for porphyria
Myasthenia Gravis
Liver Disease
LMA / emergency intubation
TIVA
Nausea Sx. - M/cly used drug

SYSTEMIC EFFECTS

1) CVS → ↓↓ syst. vascular Resistance
↓ B.P. ± Bradycardia
↑ Blunts carotid Body Ⓡ response
∴ may cause bradycardia

2) Resp.- cause Apnea longer than thiopentone
causes max depression of upper airway Reflex.
Doc for LMA / emergency Intubation
causes Histamine release but can be safely used in asthmatic pts

3) CNS - ↓ ICP, cerebral metabolic rate ↓
Anticonvulsant
may cause involuntary movements
Antiemetic
Anti-pruritic
Anti-oxidant

4) Metabolism Disease remains intact in advanced liver
Doc for Liver Disease pt
Metabolism of Propofol
70% Liver ← → 30% Kidney & lung

* PROPOFOL INFUSION SYNDROME

Metabolic acidosis

Skeletal myopathy — Acute cardiomyopathy

→ It is seen in children on prolonged infusion due to failure of metabolism of ~~fatty~~ FFA

→ Carries ↑ mortality Rate

* TIVA (Total I.V. Anaesthesia)

⇒ DOC = Propofol + Ramifentanyl

Propofol ↓ associated with quick recovery

Ramifentanyl ↓ Ultra short acting opoid

⇒ USE – neuro Sx
Day care Sx
Malignant hyperthermia

⇒ ↓ Nausea vomiting

* NEUROLEPT ANALGESIA

Droperidol + Fentanyl
205mg 50 µg

50 : 1

Characterised by → Immobility
→ Analgesia
→ Variable amnesia

when given along c N_2O ⇒ Neuroleptic Analgesia

DEXMEDETOMIDATE

→ α_2 agonist → like clonidine

→ Provide sedation
Analgesia
Amnesia
anxiolysis

→ used for short term in mechanically ventilated pts

→ doesn't cause resp. depression
May cause airway obstruction.

→ S/E –
1) Bradycardia
2) Hypotension
3) shouldn't be used on pt c β blocker & heart block.

* Drugs Producing Active Metabolite
Thiopentone
Methohexitol
Midazolam
Ketamine

Drugs Producing Inactive Metabolite

1) Etomidate

2) Propofol

~~Stage~~	RESP	T.V.	PUPILS	EYE POSITION	REFLEXES ABOLISHED
STAGE 1 (analgesia)	Irregular	Small	Constricted	Divergent	Nil
STAGE 2 (excitement)	,,	Large	Dilated	,,	Eyelash
STAGE 3 (surgical anaesthesia) Plane 1	Regular	,,	Constricted	,,	Pharyngeal Skin Conjunctival
Plane 2	,,	Medium	½ Dil	Fixed centrally	Corneal
Plane 3	,,	Small	¾ Dil	Central	Laryngeal
Plane 4	jerky	,,	Fully Dilated	Central	Corneal anal
STAGE 4	—	—	APNOEA	—	—

GUEDEL'S STAGES OF ANAESTHESIA

Seen in Ether

⇒ Plane 3 → Plane of surgical anaesthesia

⇒ Stage 4 → Brainstem paralysis, Brainstem paralysis

⇒ Lacrimation ↑ in Stage 3 Plane 1, 2

⇒ Lacrimation ↓ in Stage 3 Plane 3

⇒ Pupillary Light Reflex is lost in stage 4.
[Brainstem Reflex]

INHALATIONAL AGENT

ETHER

1) Pungent smelling
2) Decomposes in presence of light
3) Stored in amber coloured bottle
4) Highly inflammable & explosive
   ∟ i.o C/I ⊂ cautery
5) Good analgesia, M/s Relaxant, complete anaesthetic agent
6) Doesn't depress HR/P or myocardium
7) Potent Bronchodilator
8) Only agent ⊆ depresses mucociliary activity

ETHEROMANIA

→ Dependence or addict of ether

METHOXY FLURANE

- Most Potent Inhalational agent
- Lowest MAC - 3%
- Highest B.P. → 105°c
- Highest Blood Gas Coefficient 15
- Extensively absorbed in rubber tubings
- " metabolised to > 70% to Flouride ions (high levels)
  ↓
- can cause vasopressin resistant High output Renal failure.
- Hepatotoxic

TRIELENE

- Most potent analgesic agent
- Reacts with sodalime
- → used for Labour Analgesia

CYCLOPROPANE

- Causes sympathetic stimulation
- useful in shock pts.

CHLOROFORM

Very sweet smelling

Cause ↑ incidence of Nausea & vomiting

Cause sudden death by Ventricular fibrillation

Cause hyperglycemia - avoided in DM

Hepatotoxic

24/5/18

MAC (Min. Alveolar Conc")

Min. alveolar conc" at ≤ 50% of pt: will not respond to stimulus.

Stimulus is usually a abdominal skin incision

MAC = potency of anaesthetic agent

Low ~~MAC~~ = MAC = more potent

eg. methoxyflurane 0.3%

High MAC = Low potent

eg. N_2O 105%

FACTORS ↑ MAC

1) children [Infants > Neonate]
2) Anxiety
3) Hyperthermia > 42°c
4) Hypernatremia
5) Chr. ingestion of alcohol, cocaine
5) Acute amphetamine

Infants > Neonate > Adults

FACTORS ↓ MAC

1) old age
2) opoids
3) Sedatives
4) Hypoxia
5) Hypothermia
6) Hyponatremia
7) Hypercalcemia
8) ♀
9) Anaemia
10) Lithium
11) Acute alcohol, cocaine
12) Chronic amphetamines.

* MAC ↓ by 6% for every decade of life.

MAC_{95} = min. alveolar conc^n at which 95% of ~~the~~ patients will not respond to stimuli

= 1.3 x MAC

MAC_{awake} = min. alveolar conc^n at which 50% of pts will become awake.

= 0.3 x MAC

* BLOOD GAS PARTITION COEFFICEENT :-

It is the solubility of the agent in the blood

Less soluble the agent = Lower is B/G coefficent

⇓

Faster Induction & Recovery

Eg. Xenon, Desflurane

Xenon = ~~17~~ 0.17

Desflurane = 0.42

N_2O = 0.46

Sevoflurane = 0.60

Agents ∝ ↑ B/G coefficent :-

Low Induc^n & Recovery

Eg. Ether = 12

Methoxyflurane = 15

* ~~OIL~~ OIL GAS PARTITION COEFFICIENT :-

It is the solubility of agents in lipid

higher solubility = more potent

Less " = Less "

N_2O

Laughing Gas

→ Prepared by heating $NH_4NO_3 \xrightarrow{250^\circ C} N_2O$.

→ colourless, odourless gas

→ supports combustion like O_2
hence not used for laparoscopy

→ 1.5 times heavier than air

→ 35 times more soluble in blood than N_2.

MAC N_2O : 105%

B/G coefficient = 0.46

SYSTEMIC EFFECTS-

CVS - PR ↑ BP Stable
↑ Pul. vascular Resistance
shouldn't be used in Pulmonary HTN pt

Resp - ↓ Tidal volume
↑ RR
Inhibits carotid body hypoxic drive

CNS - ↑ cerebral metabolic rate
↑ ICP
provides analgesia
doesn't affect CSF secretion & absorption

Toxicity of N_2O :-

1) Expands any air containing cavity

* If given for >6hrs ⇒ irreversibly oxedises Cobalt atom of vit B_{12}

⇓

Inhibition of Enzymes.

Methionine Synthetase &

Thymidalate Synthetase

⇓

Bone marrow Depression.

↓

Megaloblastic anaemia
Peripheral neuropathy
pernicious anaemia

* It may be teratogenic
Female anaesthetists tend to have ↑ rate of 1st trimester abortion

* causes max. greenhouse effect among anaesthetic agents

* Chronic exposure to N_2O ⇒ Spinal Degeneration.

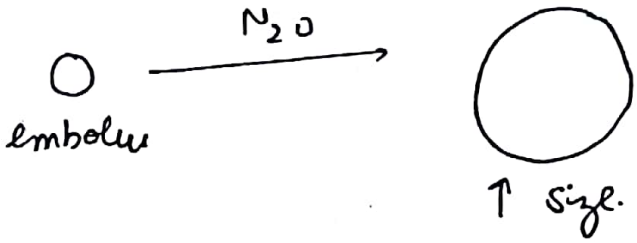
C/I of N_2O -

1) N_2O expands any air containing cavity

∴ C/I → 1) venous air embolism

↓

occurs m/c/y in sitting position for post. fossa surgeries.



Most sensitive monitor to detect venous air embolism =

Trans oesophageal Echo > Doppler > ETN_2 > $ETCO_2$ > CVP > Mill wheel murmur

2) Pneumothorax

N_2O ↑ the size

3) Lung cyst or bulla

4) Intracranial Sx

↳ Especially post. fossa Sx

Post. fossa is a bony space.

So, N_2O → ↑ pressure as vol. can't be ↑

⇓

Pons & medulla can be affected

5) Pneumocephalus-

N_2O is C/I for 7 days

6) Vitreoretinal Sx-

- Vitreous fluid will come out during Sx.
- To maintain vol. betn Ant. Post chamber → Surgeon puts bubble of SF_6

↓

Later vitreous comes back

If N_2O is used → it ↑ the size of bubble

~~may~~

⇓

Surgeon opens it immediately

↓

Sudden decompression

↓

Retinal detachment

7) Tympanoplasty

Due to ↑ pressure, Graft gets dislodged

8) Acute Intestinal obstruc^{n}-

N_2O causes further dilatation of loop.

9) Pulmonary HTN

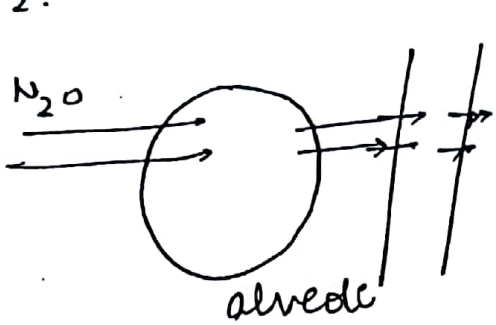
N_2O diffuses into endotracheal tube cuff

↓

cuff pressure should be intermittently monitored.

Conc^n EFFECT :-

→ N_2O is 35 times more soluble in blood than N_2.



rapid absorp^n of N_2O in blood
↓
-ve conc^n gradient in alveoli
↓
more absorp^n of N_2O
↓
Shortening induc^n time

2nd GAS EFFECT :-

N_2O also ↑ conc^n of other inhalational agent this way.

Rapid Induc^n of anaesthesia

DIFFUSION HYPOXIA / FINK'S PHENOMENON :-

Seen in old + sick pts. ~~in the~~ breathing room air at end of anaesthesia

$O_2 + N_2O$ (anaesthesia) ⟶ Room air $N_2 + O_2$

So, N_2O comes back from blood to alveoli due to conc^n gradient
↓
Diffusion Hypoxia

Rapid diffusion of N_2O from blood to alveole
dilute alveolar O_2
⇓
Hypoxia

Prevention:-
QQ By giving 100% O_2 at the end of anaesthesia

ENTONOX
[50% O_2 + 50% N_2O]
Used for Labour analgesia
Dental anaesthesia

POYNTING EFFECT :-
→ At -6°c - O_2 & N_2O separates into layers
→ Pt. 1st breathes only O_2 ⇒ so no pain relief
then only N_2O ⇒ hypoxia.

Prevention-
By shaking cylinder before use

HALOGENATED INHALATIONAL AGENT

HALOTHANE

1) It is alkane other agents are ether
2) contains Bromine atom., Cl^-, F^-
3) very sweet smelling
4) undergoes spontaneous decomposition & is retarded by Thymol preservative (0.01%)
5) absorbed in rubber tubings
6) reacts with metals in vaporisers.

SYSTEMIC EFFECTS :-

CVS -. Direct myocardial depression
↓
Leading to fall in BP

. Halothane blunts carotid Body receptor response
↓
So, Bradycardia occurs

. It makes heart sensitive to arrhythmogenic effects of adrenaline.
[Cocaine is C/I with halothane].

Resp :- Potent Bronchodilator.
DOC for asthmatic pts.

- causes severe depression of hypoxic ventilatory drive

CNS - potent cerebral vasodilator.

↑ ICP.

Q How to ↓ ICP?

1) Mannitol

2) Glycerol

3) Hyperventilation ⇒ for acute ↑ ICP

4) Raise head of bed by 30°

5) VP shunt

6) 3% saline ⇒ acute & chronic ↑ ICP.

7) Extraventricular drainage

CO_2 is most potent vasodilator.

* On Hyperventilation

↓

↓ arterial CO_2

↓

Cerebral vaso constric^{n}

↓ ↓ cerebral blood flow

↓ ICP

Halothane ⟶ ✱

Q C inhalational agent required prior hyperventelation

↳ HALOTHANE to prevent rise in ICP.

→ Halothane doesn't provide analgesia

- can cause shivering : HALOTHANE SHAKES
  ↓
  Best antidote
  PETHIDINE

- potent uterine Relaxant
  DOC for manual removal of placenta

→ use of halothane for LSCS ↓ Cr.A
  ↓
  PPH

→ causes max ↓ in Total Hepatic Blood flow & Portal Vein Flow.

→ maximally metabolised >20%
  Metabolised to ~~Fluoride~~ Trifluoroacetic acid
  ↓
  Immune mediated hepatitis

Pathology - Centrilobular necrosis

Mortality : 30-50%

Predisposing Factors-

→ Multiple exposures at short interval of time
  Time interval should be > 3 month

→ Middle age obese women

→ ℞/ Family H/o toxicity

C/I

1) ↑ ICP
2) unexplained liver dysfunc° after exposure
3) Pheochromocytoma → ↑ adrenaline levels.
4) Malignant Hyperthermia
5) Aminophylline → causes arrhythmia

~~TRIGGERS~~

ENFLURANE

→ It is ether
→ cause tonic & clonic convulsions
C/I → epilepsy pts
→ Trigger for Malignant Hyperthermia
→ mildly ↓ Renal concentrating ability
°° C/I in pre-existing renal diseases

ISO FLURANE

→ Chemical Isomer of enflurane
→ pungent smelling ether.

SYSTEMIC EFFECTS-

CVS → Peripheral vasodilatation
↓ B.P. ∵ ↑ H.R.
DOC for deliberate hypotensive anaesthesia

BP can be lowered upto 20% of baseline value

→ Powerful coronary artery vasodilator.
Adc for cardiac Sx

→ It may be associated ē coronary steel syndrome but clinically insignificant

Resp

causes mild Bronchodilatation. • Tachypnoea

CNS

cerebral vasodilatation.

↑ ICP

⇓

can be ↓ by simultaneous hyperventilation

causes **isoelectric EEG** at **2 MAC**

COND" CAUSING EEG ACTIVATION

1) Subanaesthetic doses of inhalational agent < MAC
2) Low dose of Barbiturates
   Etomidate
   Benzodiazepines
3) N_2O
4) Ketamine
5) Sensory stimulation
6) mild Hypercapnoeia
7) early Hypoxia

COND' CAUSING EEG DEPRESSION

1) > MAC of inhalational agents
2) Normal dose of Barbiturates
   opoids
   Propofol
   Etomidate
3) Hypocapnea
4) Marked Hypercapnea
5) Hypothermia
6) Late hypoxia

- Isoflurane maintains Total hepatic blood flow
  × portal vein flow
- also maintains hepatic venous oxygenation.
  Doc for Liver Transplant Sx

C/I

1) Severe hypovolemia
2) malignant hyperthermia

DESFLURANE

→ **Most pungent** smelling ether

Desflurane > Iso > Sevo > Halothane

Desflurane: Most pungent

Halothane: most sweet smelling

→ It has lowest Blood Gas ⊖ coefficient among flourinated agents - 0.42

↓

Rapid induc" & recovery

→ causes airway irritation

1) Breath holding
2) ~~cutting~~ coughing
3) Salivation
4) Laryngospasm

→ So, not used for inhalational ⊖ induc" in CHILDREN.

→ has low B.P. 23°c & very high vapour pressure

→ Requires a special vapouriser → heated to a temp. of 39°c.

→ Sudden ↑ in desflurane conc^{n} causes sympathetic stimulation → HTN & Tachycardia

→ minimally metabolized < 0.1%

→ max. greenhouse effect among flourinated agents.

→ Reacts ₹ dry CO_2 absorbent. to form CO

→ cause Emergence Delirium in children.

C/I-

1) severe hypovolemia
2) Malignant Hyperthermia
3)

SEVO FLURANE

→ It is mildly sweet smelling ether

→ Max no. of flourine atoms → (7)

→ has low B:G coefficient ⇒ FAST Induc", recovery

Agent of choice for ① inhalational ~~agent~~ Induction

② Day care Sx

③ neuro Sx

↳ cause minimal cerebral vasodilatation so, ICP doesn't ↑.

Can cause emergence delirium in children

doesn't ₹ show hepatic toxicity since not metabolized to ₹ trifluoroacetic acid

→ Sevo flurone + Sodalime ⇒ Compound A

↓

nephrotoxic

→ Compound A formation can be prevented by using fresh gas flow rate >2L/minute

→ Sevo degraded by metal/ environment ⟶ HF (Hydrogen floride)

↓

acid burn of resp. mucosa

C/I -

1) severe hypovolemia

2) malignant hyperthermia

HELIUM

→ non-flourinated agent

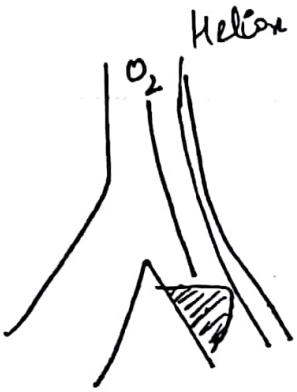
→ 79% Helium + 21% O_2 ⇒ HELIOX

↓

density is lighter than air

↓

% useful in Larger airway Obstruction



XENON

→ Weak anaesthetic like N_2O

→ MAC - 70%

→ Lowest B:G coefficient → 0.17%

→ Most closest to Ideal anaesthetic agent

→ Provides analgesia

Agent of choice for Liver Disease Patients

ADVANTAGE -

1) Minimal CVS & resp. effects

2) Rapid Induc + Recovery

3) Low B:G coefficient

4) Minimum metabolism

5) Is inert

6) doesn't react ~~c~~ sodalime

7) non-inflammable & non-explosive

8)

DISADVANTAGE

1) High cost

2) Low potency.

MUSCLE RELAXANTS

- CENTRALLY ACTING
  - DANTROLENE
  - BECLOFENE
- ACTING AT N-MJ^
  - Depolarising
    - Succinyl choline
    - Resembles Acetylcholine
    - (Non-competitive BLOCKADE)
  - Non-Depolarising (competitive Blockade)

→ M/s Relaxants used in anaesthesia act upon NMJ^.

DEPOLARISING BLOCK

→ Causes non-competitive Blockade

→ Causes muscular fasciculation

→ M/s remains un-responsive to other stimuli

→ Not reversed by Neostigmine

Neostigmine $\xrightarrow{\ominus}$ AChE

↓

↑ Ach.

→ Succinyl choline is ϕ

→ Potentiated by

Mg
Hypothermia
Resp. alkalosis
Isoflurane

Antagonised by

- Non-depolarising M/L relaxant
- Antagonist

- ~~Do not~~ No Fade on Train of Four
- Stored in Refrigerator - 2-5°C
- Once removed from refrigerator, it should be used in 2 weeks
- DOSE = 1-1.5 mg/kg
  Adults → 1. mg/kg
  children - 1.5 mg/kg
- If given in dose of 7-10 mg/kg B.W.
  ↓
  causes conformational changes in receptor
  ↓
  Block starts behaving like non-depolarising
  Block = PHASE 2 BLOCKADE
- Features of phase 2 Block are similar to non-depolarising Block

ONSET Time = 30sec — Last for 5-10min.

M/s Relaxant of choice for full stomach Pts.

⇒ Bradycardia especially in children. after 2nd dose

→ cause masseter m/s spasm in children

↓

These children are more prone to malignant Hyperthermia

→ (↑) → ICP
IOP
BP
Gastric Pressure
LE sphincter Tone

→ Metabolised by Plasma Pseudocholinesterase

↓

controlled by 2 set of genes

- If pt. is homozygous ⇒

→ Atypical Pseudocholiesterase

→ Prodn of pseudocholiesterase & Ab (N) is both genes are absent.

↓

c leads to ↑ duration of SCHOLINE APNDEA

Rx - Continue c mech. ventilation, FFP

DIBUCAINE NO.

% inhibition of Plasma pseudocholinesterase by dibucaine

(N) → 75-80%

Ab (N) < 30%

* Plasma pseudocholinesterase Def.n :-
  ↳ seen in Hepatic failure
  Renal failure
  Cancers
  malnutrition
  ♀
  Hypothyroidism

→ S. choline ↑ K by 0.5 meq/L
The ↑ occurs more after

a) Burns
b) Spinal cord injury
c) Stroke
d) GB syndrome
e) Prolonged ICU stay
f) sev. intra-abdominal infn
g) Tetanus

] Sch is C/I 48 hrs - 9 mnths after these Condn.

→ S.Ch. caused muscular fasciculation.
& lead to post-op myalgias

⇓

Fasciculations can be ↓ by giving small dose of non-depolarising m/s relaxant before S.Ch

↳ Agent of choice = **ROCURONIUM.**

→ S.Ch is M/c triggering factor for malignant Hyperthermia.

C/I

1) muscular dystrophy
2) In Dystrophica myotonica → it causes sev. m/s rigidity preventing resp. & Intubation.

Mx of Pt. suffering from M/s Dystrophy

1) Sch C/I
2) Inhalational agents to be avoided
3) I.V. Induc" preferred

2) Sch causes Histamine release
" " Ganglionic stimulation

* COMMON FEATURES Bet DMR, NDMR^{80}

1) Drugs ⊆ can be used in renal failure:
   a) Atracurium
   b) Cis-atracurium
   c) Scholine
   d) Mivacurium

2) * Order of Paralysis by M/s Relaxant
   Ptosis → Diplopia → ~~fever~~ facial → Jaws → neck.
   → Limbs → **Diaphragm.**
   ↓
   1st M/s to recover from paralysis

3) Histamine releasing drugs.
   Atracurium
   Mivacurium
   Scholine
   D-Tubocurine — Max histamine Release

4) Sch caller → ganglionic stimulation
   D-Tubocurine → ganglionic Blokade

5) Vagolytic activity -
   Gallamine → MAX.
   Pancuronium

Sympathetic stimulation occurs ε
→ Gallamine
→ Pancuronium

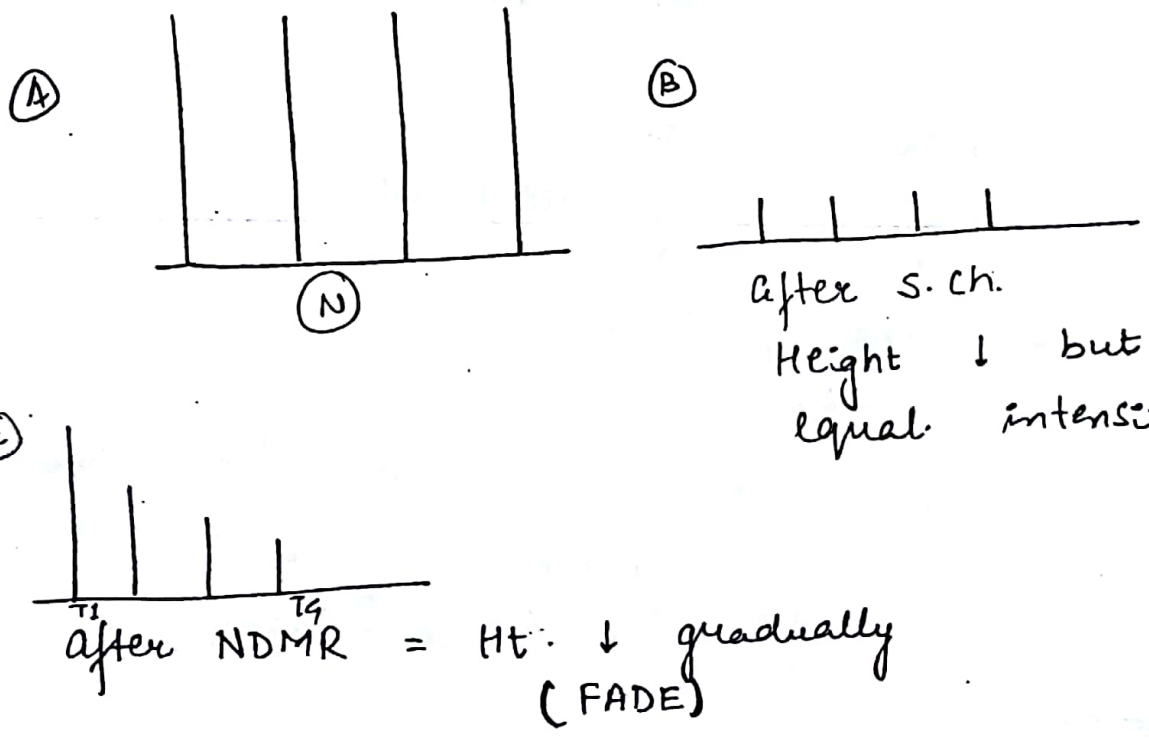
* N.M. MONITORING

→ M/c nerve used = ULNAR
→ M/c muscle used = ADDUCTOR POLLICIS M/c
→ M/c corresponds to Laryngeal paralysis
= Orbicularis oculi
→ M/c mode of NM ~~Train~~ Transmission = TRAIN OF Four

O O O O
←0.5sec→

4 stimulus → frequency of 2Hz
Duration bet 2 stimulus is 0.5sec

ToF measured at interval of 10sec



$\frac{T_4}{T_1}$ = TOF Ratio

NON- DEPOLARISING M/s RELAXANT

- BENZYL ISOQUINIDIUM
- AMINOSTEROIDS
- CHLOROFUMARATES

① BENZYL ISOQUINIDIUM

↓ ATRACURIUM

→ Intermediate acting

→ Metabolised → $\frac{1}{3}^{rd}$ by HOFFMAN DEGRADATION (Non-enzymatic, Temp. + PH dependent degradation)

$\frac{2}{3}^{rd}$ by Alkaline ester Hydrolysis

→ Produces metabolite LAUDONOSINE
↓
can cause convulsions

→ Causes histamine release

Doesn't require any reversal agent

→ DOC → renal failure
hepatic failure
Pts ⊂ atypical pseudocholinesterase
Pts ⊂ myasthenia gravis
[$\frac{1}{10}^{th}$ of ⓝ dose used]

CIS- ATRACURIUM

→ Isomer of atracurium
→ Metabolised 100% by HOFFMAN degradation
→ Laudanosine level are lower
→ Preferred over atracurium
→ ND histamine release

MIVACURIUM

→ Slow onset
→ short duration of action
→ Given by continuous infusion
→ M/s relaxant of choice for Day care Sx

D-TUBOCURINE

→ Long acting
→ mainly metabolised in Kidneys
→ causes ganglionic Blockade
Preferred in arterial Sx
→ Causes max. histamine release

DOXACURIUM

→ Most potent
→ Longest acting NR

(II) AMINO STEROIDS MR

VECURONIUM

- Intermediate Acting
- Mainly Hepatic metabolism
- Most cvs stable agent (MR)

ROCURONIUM

- Most Rapid onset among NDMR
- NDMR of choice for full stomach pts.
- causes pain on Injec.
- Less potent
- Specific Reversal Agent = SUGAMMADEX

RAPACURONIUM

- Rapid onset of action
- causes high incidence of Bronchospasm in Children → ∴ withdrawn.

PANCURONIUM

- Long acting
- Vagolytic
- causes Sympathetic stimulation So useful in SHOCK Pts.

should be avoided in Ischaemic Heart Disease pt.

GALLAMINE

→ only MR to cross PLACENTA → C/I in ♀

→ Least potent MR

→ Metabolised 100% by kidneys ⇒ C/I in Renal diseases.

→ Max. vagolytic activity

METOCURINE

→ Metabolised 100% by kidneys

→ Contains Iodine → C/I in Iodine sensitivity Pts

(III) CHLOROFUMARATES

CANTACURIUM

→ Ultra-short acting MR

→ Metabolised to CYSTIENE

→ Specific reversal agent : L-CYSTEINE

* FACTORS PROLONGING NM BLOCKADE :-

1) newborns
2) old age
3) Renal / Hepatic failure
4) Inhaled Anaesthetic agent
   - Max → Desflurane
   - Men → N_2O

5) Aminoglycoside, Polymyxins] → they themselve cause NM Blockade

6) Local anaesthetic

7) Hypokalemia

8) Hypocalcemia

DRUGS ANTAGONISING NM BLOCKADE

1) Phenytoin
2) Carbamazepine
3) Calcium

REVERSAL OF NM BLOCKADE :-

1) Neostigmine :-

↑ Ach by blocking AChE. enzyme

Advantage :- It is Quarternary ammonium Compound
∴ doesn't cause BBB
So no central effects seen

S/E- Bradycardia → may cause cardiac standstill
Bronchospasm
↑ Bladder tone
↑ secretion
↑ Peristalsis
Meosis

Neostigmine always combined ē Atropine or Glycopyrrolate.

2) Pyridostigmine

3) Edrophonium

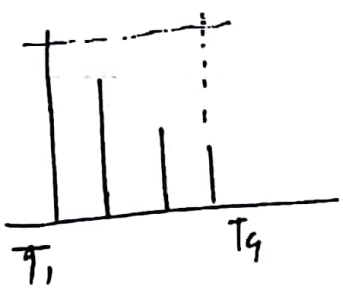
4) Suggamadex → for Rocuronium

5) L-cysteine → for Cantacurium.

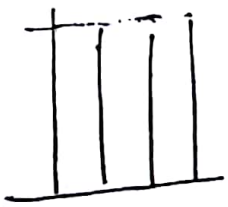
* SIGNS OF ADEQUATE REVERSAL

1) Spontaneous limb movement
2) Able to follow command
3) Able to show tongue
4) Spontaneous help ī adequate Tidal volume
5) BEST SIGN → Head Lift > 5 sec.

BEST OVERALL SIGN = T.OF RATIO > 0.9



T_4 ī 90% of T_1.



Pt Divided Into 2 GROUPS

ELECTIVE

NPO.

Preoxy + (3min) MR. + I.V. ind" +

100% O_2

Ventilate ⊽ Bag, Mask

Intubate the pt.

EMERGENCY

Full stomach

Preoxygenate | 100% O_2 | for 3min.

+ I.V. Induction

+ MR. having faster action Such Rocuronium

NO IPPV

Bag, Mask

↓

Pressure applied on cricoid cartilage (SELLICK's MANAUVERE)

↓

Intubate ⊽ cuff tube

Rapid Sequence Induction

LOCAL ANAESTHETIC AGENT

Weak bases

N/V FIBRES – (A) (B) (C)

(A) → Largest

(B) → Myelinated

(C) → smallest → unmyelinated

Aα ← Efferent to M/s → Mediate motor func"

Aβ ← Afferent from skin & Joints → mediate Tactile proprioception

Aγ ← Efferent to m/s Spindle → mediate M/s tone

Aδ ← Afferent to sensory n/vs → mediate temp. & pain. touch sensation

Myelinated → Autonomic preganglionic fibres → ANS

Unmyelinated → Autonomic postganglionic fibres → ANS

Unmyelinated → Dorsal root → Pain & Touch

Sensitivity to LA :- (Peripheral n/vs)

$A\gamma > A\delta > A\beta = A\alpha > B > C$

Sensitivity to Hypoxia

$\boxed{B > A > C}$

Sensitivity to Pressure

$\boxed{A > B > C}$

Order of Blockade :

Autonomic → Sensory → Motor

↓

Temp.

↓

Pain

↓

Touch

↓

Pressure

↓

Proprioception

Recovery in reverse order

L.A.

AMINO ESTERS	AMINO AMIDES
- Metabolised by Plasma Pseudo cholinesterase	In Liver
- except cocaine	
→ Unstable sol^n	Stable
→ metabolised to PABA ↓ → Responsible for high incidence of allergic Rxn	Less incidence of allergic Rxn.

SEQUENCE OF ALLERGIC RXNS –

MR > Later products > Antibiotics

SHORTEST acting LA ⇒ CHLORPROCAINE

INTERMEDIATE " " ⇒ LIGNOCAINE
COCAINE

LONG Acting " ⇒ BUPIVACAINE
ROPIVACAINE.

single i in spelling = ester

double i in " = amide

PHARMACOKINETICS

1) ABSORPTION -

Depends on.

a) Site of Injec^{n} -

more vascular site = faster absorption
= shorter duration of action.

Order of absorp^{n} -

I.V. (I.A.) > Tracheal > Intercostal > Paracervical > epidural > Brachial plexus > Sciatic > ~~femoral~~ Subcutaneous.

b) Dose :-

Higher dose : Longer blockade
Lower dose : shorter blockade

c) Addition of vasoconstrictor

Adrenaline
↓
↓ absorption
↓
Longer duration of action.

d) pharmacological profile of drug

short acting ← Intermediate → long acting

MOA of LA

→ Acts upon nodes of Ranvéer

→ LA enter axons in undissociated form.

↓

devide into axons

↙ ionic part ↓ Blocks Na+ channel

↘ Non-ionic part

→ pH at ≤ 50% of drug is ionic, 50% non-ionic

k/n/a → pKa

→ Drug having pKa value closer to physiological pH = faster acting than other drugs.

Lignocaine 7.8 ⇒ faster acting

Bupivacaine 8.1 ⇒ slower "

→ Differential sensory Blockade :-

↳ shown by BUPIVACAINE + ROPIVACAINE

ⓐ Low conc" ⇒ only cause Sensory Block

ⓑ High conc" ⇒ Ⓑ sensory + Motor Block

It is used in LABOUR ANALGESIA.

EFFECT OF ADDITION OF OTHER AGENTS

1) ADRENALINE :-

Lignocaine + Adrenaline = ↑ motor Block + ↑ sensory Block

Bupivacaine + Adrenaline = ↑ sensory Block

Adrenaline used in conc^{n} of 1:200000

2) PHENYLEPHRINE :- (1:20,000)

↳ causes less tachycardia

3) SODA BICARB :-

Leads to faster onset

Longer duration of action.

Less subcutaneous pain

Better Quality

TOXICITY OF L.A.

1) **CNS TOXICITY**

a) Circum oral numbness

b) paraesthesia of tongue

c) light-headedness

d) dizziness —F/B→ auditory, visual c) disturbances

f) m/s twitching

g) tremors

h) convulsions

R_x → small dose of Thiopentone or Propofol
secure airway
BZDs
Anticonvulsants

2> **CNS TOXICITY**

→ Bupivacaine forms irreversible complexes ī Receptors of Heart → ∴ should never be given as I.V. Injec^n.

→ R_x = 20% Intralipid emulsion [TPN].
Prolonged CPR
Adrenaline ,
Amiodarone

3> **METHGLOBINEMIA**
Seen ī large doses of Prilocaine & Benzocaine

R_x → Methylene Blue

LA + Adrenaline ⇒ shouldn't be used for Ring blockade of
Finger
Toe
Penis
Pinna
→ contain end arteries

1) **LIGNOCAINE**

→ M/cly used LA

→ Conc" used are 5% heavy for spinal anaesthesia
4% topical
2% epidural
1% n/v block.
5% IVRA
2% Jelly for urethral procedures

Max. Safe Dose = 4.5mg/kg ī but adrenaline
7mg/kg ī adrenaline

BUPIVACAINE

- Long acting
- Never to be used I.V.
- Conc" used are 0.5% heavy for spinal
0.0625 - 0.125% - painless Labour
0.25% → n/v Blocks

Max. safe dose = 3mg/kg Body wt

BENZOCAINE

→ 20% topical agent for endoscopy / Bronchoscopy
→ can cause Methglobinemia

COCAINE

→ C/I ī adrenaline
→ used as 4% topical anaesthesia of eye

PROCAINE

→ L.A. of choice for pts. c̄ H/o Malignant Hyperthermia

CHLORPROCAINE

→ Fastest acting
→ C/I for spinal anaesthesia → causes neurotoxicity

TETRACAINE

0.5% for spinal anaesthesia
4% for topical anaesthesia

EMLA

→ Eutectic mixture of L.A.
→ Combination of 2.5% Lignocaine + 2.5% Prilocaine
→ to ↓ needle phobia

can also be used for skin grafting circumscion.

shouldn't be applied on cut surface mucous membrane

BIER'S BLOCK / I.V.R.A.

→ Used for Upper Limb & Lower Limb Sx

→ 2 Tourniquets are applied

→ DOC → Lignocaine 0.5%
Prilocaine 0.5%
Bupivacaine → C/I

C/I to Block –

1) sickle cell Disease
2) Scleroderma
3) Raynaud's Disease

CELIAC PLEXUS BLOCK

- Given for Pain relief of
Pancreatic Ca
Gastric Ca

→ causes blockade of Lumbar sympathetic chain

S/E-

→ Hypotension, Diarrhoea - M/c

BRACHIAL PLEXUS BLOCK

4 PLACES

1> Interscalene Block

↳ Bet^n scalenus medius & scalenus Ant. M/s

→ Shoulder Sx can bed done

→ Ulnar n/v is spared

→ Below shoulder, Sx can't be done

Comp^n-

1) Phrenic N/v Blockade - 10% cases

C/I in C/L Hemidiaphragmatic Paralysis

2) HORNERS SYNDROME

3) Vertebral artery Inj^n

4) Spinal/epidural anaesthesia

5) RLN Block → hoarseness of voice

6) pneumothorax

2) SUPRA CLAVICULAR BLOCK.

→ Given just lateral to subclavian artery

→ **Below shoulder Sx** can be performed

→ **Axillary + suprascapular n/v are spared**

Comp^n -

1) Phrenic n/v Blockade - 50% case

2) pneumothorax - 2-3% of case

3) vascular Injec^n.

3> INFRA CLAVICULAR BLOCK

Below elbow Sx can be performed

Intercostobrachial n/v is spared

Comp^n -

1) pneumothorax

2) vascular puncture

4> AXILLARY BLOCK.

→ Given in axillary sheath

→ Transarterial

→ **Musculocutaneous n/v is spared**

→ Comp^n -

vascular puncture

STELLATE GANGLION BLOCK

CERVICOTHORACIC BLOCK

→ It is used for pain relief of upper limb (UL) + Vasospastic disorder of UL

→ Given at Transverse process of C_6 vertebrae

– Paratracheal

→ Succesful stellate ganglion Block accompanied by HORNER SYNDROME -

→ Comp^n -

1) RLN Block → hoarseness of voice
2) Spinal/ epidural Inj^n
3) vascular puncture
4) Mediastinitis if oesophageal puncture occurs.

SPINAL ANAESTHESIA

SUBARACHNOID BLOCK / CENTRAL NEUROAXIAL BLOCKADE

CSF lies betn arachnoid & Pia

Spinal cord ends at Lower border of L_1 Or upper border of L_2

↓

∴ spinal anaesthesia is given L_{2-3} to L_5S_1 space

STRUCTURES PUNCTURED DURING SPINAL ANAESTHESIA

1) Skin
2) subcutaneous tissue
3) ~~Supraspinous~~ lig. supraspinous
4) ~~Infraspinous~~ lig Infraspinous
5) Ligamentum flavum
6) Dura
7) Arachnoid.

⇒ Highest point of iliac crest corresponds to L_{4-5} space

POSITION OF ~~SPINAL~~ PATIENT

1) Sitting
2) Lateral
3) Prone / Taylor approach.

SITE

1) **Midline**
2) **Paramedian**
   ↓
   Bypass supraspinous + Infraspinous lig. ∴ may get calcified in old age patient

DRUGS USED

1) Lignocaine 5% heavy - 1-1.5 mL or 50-75 mg
2) Bupivacaine 0.5% heavy - 2-3 mL or 10-15 mg
   → Made heavy by addition of dextrose
   → Heavy means specific gravity is more than that of CSF.

NEEDLES USED

1) **Pencil tip needle**
   or
2) Atraumatic needle
   ↓
   Less incidence of post spinal headache
   H/ely used size = 25 Gauge

2) **Non Pencil Tip needle**
   [Drug port is at the tip of needle].

FACTORS AFFECTING HT. OF SPINAL ANAESTHESIA

1) DOSE → Most Imp factor
   ↑ Dose → high spinal
   ↓ Dose → low spinal

2) VOLUME-
   ↑ Volume → ↑ Dose
   ↓ Volume → ↓ Dose

3> BARICITY

It is sp. gravity of drug to CSF

4> POSITION OF PATIENT-

Head down → High Blockade

5> PATIENT FACTORS-

i> age:-

old age pts. ligaments are calcified

↓

Space around cord ↓

↓

Pressure inside cord ↑

↓

Hence, Drug dosage ∞ is ↓ in old age pt.

ii> Height:-

Taller person requires more volume

shorter " less volume

iii> ♀:-

†

In ♀ → there is pressure upon IVC.

↓

Epidural plexus engorged

↓

Space around cord ↓

↓

Pressure inside cord ↑

↓

∴ Drug Dosage is ↓ in ♀.

In ♀, n/v endings become more sensitive to local anaesthetic agent.

iv) Abdominal Tumours:-
similar to ♀, no hormonal effect.

FACTORS ⊆ DO NOT AFFECT HT. OF SPINAL ANAESTHESIA

1) Sex
2) Weight
3) Direction of needle
4) speed of injection
5) Barbotage
   ↳ mixing of CSF ⊼ local anaesthetic syringe
   obselete now
6) addition of adrenaline.

SYSTEMIC EFFECT OF SPINAL ANAESTHESIA

1) CVS → vasodilatation of LL vessels
↓
↓ venous return
↓
fall in BP + ↑ HR

Spinal anaesthesia cause hypotension + Tachycardia
→ Cardiac Sympathetic supply = $T_1 - T_4$
→ High spinal may cause blockade of cardiac Sympathetic supply ⇒ Hypotension + Bradycardia

* causes of hypotension during spinal

1) ↓ VR
2) Bradycardia → ↓ CO
3) Blockade of adrenal gland
4) Local anaesthetic toxicity

* While giving spinal anaesthesia, pt. can have

Hypotension ± Bradycardia

↓

may become unconscious due to

vasovagal

Severe Hypotension + Bradycardia may also occur due to BEZOLD-JARISCH REFLEX

2) **CVS**

Autonomic

↑ 2 seg. above

Sensory

↓ 2 seg. below.

Motor

3) **Resp**

all parameters of resp. remain unaffected except Max Breathing Capacity ↓ due to Active exhalation → paralysis of Intercostal M/s.

Hegh spinal → can cause Phrenic n/v Blockade

↓

Apnoea.

℞ of apnoea-
Bag + mask ventilation.

* CAUSES OF APNOEA DURING SPINAL ANAESTHESIA

1) Hypotension leading to ↓ in Blood supply of Brain stem
2) Hegh spinal anaesthesia
3) Total spinal anaesthesia
4) Local anaesthetic toxicity

4) GIT
↑ Peristalsis + relaxation of sphincter
⇓
small contracted Gut

5) Temp
↑ heat loss due to vasodilatation
↓
Pt compensates by shivering

6) Genitourinary
→ Urinary retention due to ↓ blockade of detrusor m/s

COMP^{n} OF SPINAL ANAESTHESIA

1) **Hypotension** — M/c comp^{n}

2. Can be prevented by preloading pt c
   1 - 1.5L of colloid / crystalloid

   Rx → fast fluids
   - lower head end
   - vasopressors
     - include
       a) Phenylephrine — vasopressor of choice for LSCS
       b) ephedrine
       c) Mephentramine

2) Bradycardia
   Rx = Atropine

3) Resp. Insufficiency / Apnoea
   Rx = IPPV c Bag + mask + correc^{n} of hypotension.

4) Post spinal headache / Post dural puncture headache
- occurs due to leakage of CSF from dural puncture site
- starts 12 - 24 hrs after spinal anaesthesia
- Lasts for 7 days

→ Occipital headache usually but may be frontal

→ Low-pressure headache

→ Headache can be prevented
  1) By using pencil tip needle
  2) By " higher gauze needle
  3) By adequate hydration.

R_x = Analgesic
  Correct of dehydration
  Na coffee Benzoate
  Most definitive R_x = Epidural Blood Patch.

PREDISPOSING FACTORS FOR HEADACHE –

1) ♀ > ♂
2) young > old
3) ♀ > non ♀
4) multiple punctures > single puncture
5) Bevel ⊥ to needle fibres > Bevel to parallel fibres.
6) Timing of ambulation doesn't affect onset of headache
   Spinal catheter doesn't affect onset of headache

Headache ⓣ → sitting
Standing
ⓛ → lying down position

5) Epidural Haematoma
It can cause paraplegia

6) Paralysis of cranial n/v - 1, 9, 10th n/v are never involved
6th M/cly involved
↓
Pt. complain of diplopia

7) Meningitis

8) Ant Spinal artery Syndrome

9) Backache

ABSOLUTE C/I OF SPINAL ANAESTHESIA

1) ↑sed. ICT
2) Refusal of pt.
3) Severe hypovolemia
4) Sev. MS / AS
5) Infec" at local site
6) coagulopathy
↳ High INR, Low platelet count

for spinal, INR < 1.5
platelet > 80,000

SADDLE ANAESTHESIA

When spinal anaesthesia is given in sitting position & Pt. allowed to sit for 8-10 min

↓

effect comes in form of saddle

All perineal Sx can be done under saddle

EPIDURAL ANAESTHESIA

EXTRADURAL "

CENTRAL NEUROAXIAL BLOCKADE

- Epidural space lies 4-5cm from skin.
- continous ⊂ thoracic cavity
- ∴ a -ve pressure space
- Broadest in Lumbar Region - 0.5cm

NEEDLE - 16-18 Gauge (TUOHY'S NEEDLE)

Lignocaine 2% plain
Bupivacaine 0.125% plain
15-20ML

SITE - N/V ROOTS. (Both in spinal + epidural)

ONSET TIME - 15-20 min

IDENTIFICATION OF EPIDURAL SPACE

1) sudden loss of resistance
2) Hangeng drop technique
   ↳ sudden sucking of drop into epidural space
3) DURAN SIGN
   rapid inje" into epidural space
   ↓
   ↑ rate , depth of Breathing
4) WESTPAL SIGN
   -nce of knee jerk after epidural anaesthesia
5) Mc intosh Indicator

ADVANTAGE OF EPIDURAL OVER SPINAL

1) gradual hypotension
2) Any duration Sx can be performed
3) Post op pain relief
4) NO post spinal headache

DISADVANTAGE OF EPIDURAL

1) Delayed onset
2) Patchy effect → septa in epidural space

3) Technically more difficult
4) expensive
5) Total spinal anaesthesia

COMBINED SPINAL EPIDURAL ANAESTHESIA

(B) spinal + epidural catheter
↓ faster onset ↓ Long term effect

CAUDAL ANAESTHESIA

→ Blockade of sacral epidural space
→ Used for pain relief of infra umbilical S$_x$ in children

MISCELLANEOUS POINTS

1) CVS Disorder in ♀ ⇒ epidural anaesthesia
2) 1st stage of Labour: T_{10} - L_1 Blockade reqd.
epidural can be given @ 4-5 cm of dilatation
3) 2nd stage of Labour = Pudendal N/v Block $S_{2,3,4}$
4) Forceps Delivery: SADDLE BLOCK
5) LSCS → T_4 to S_5 reqd.
6) M/c cause of Mortality of LSCS in under Spinal Anaesthesia: High spinal anaesthesia

S|E OF SPINAL OPOIDS

1) delayed Gastric emptying
2) Pruritus
3) nausea & vomiting
4) urinary retention
5) Sedation
6) ~~delayed~~ delayed resp. depression.

Ramifentanyl is C/I for spinal anaesthesia
It contains glycine → cause neurotoxicity

MALIGNANT HYPERTHERMIA

→ Syndrome of rapidly rising temp & occurs due to Ab Ⓝ of Ryanodine Ⓡ

↓

∴ cause massive release of calcium

↓

sustained muscular contraction.

* TRIGGERING FACTORS-

1) S. Choline – 50% of case
2) Ether
3) Methoxyflurane
4) All flourinated inhalational agents

* C/F–

1) Most initial sign - Masseter M/s SPASM.
2) Tachycardia
3) Rise in ET CO_2
4) Metabolic acidosis
5) Cyanosis
6) Hyperkalemia
7) Hypernatremia
8) Hyperphosphotemia
9) Myoglobinuria

10) Rise In Temp → Late sign.

11) Renal failure

℞-

1) Stop all anaesthetic agents

2) Hyperventilate ĉ 100% O_2

3) Inj^{n} DANTROLENE - 2mg/kg B.W. every 5min
Max 10mg/kg

4) $NaHCO_3$ → for metabolic alidosis

5) Cooling of body

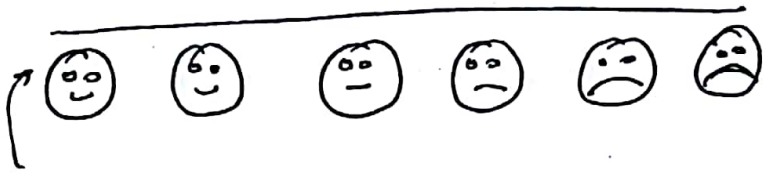
6) other symptomatic Rx.

BEST SCREENING TEST → Creatine kinase

Δstic TEST → Halothane caffeine
Contracture test

ASSESMENT OF PAIN

1) VISUAL ANALAG SCALE →



2) WONG BAKER FACES

Used for children 1-3yrs of age

Best Rating method

3) Children Hospital Estern Ontario Scale (CHOPS

→ 1-7yrs of age children

→ consist of cry

Facial

verbal

Torso

Legs

Touch.

4) Magill Questionaire

→ For minor Sx In children → PCM suppository is sufficient

→ for major Sx - Low dose narcotic infusion is used

PCA (Pt. Controlled Analgesia)

Route - I.V.

Drugs - Fentanyl or Morphine

FLUID REQUIREMENT DURING ANAESTHESIA

4 : 2 : 1

1st ~~Day~~ 10 kg → 4mL/kg

10-20 kg → 2mL/kg

> 20 kg → 1mL/kg

60 kg = 10 × 4 + 10 × 2 + 40 × 1

= 40 + 20 + 40

= 100mL

No. of fasting hours = n

100 × n = 100 n

50% - 1st hr

25% - 2nd hr

25% - 3rd hr

TYPES OF FLUID

HYPOTONIC

5% Dextrose

1/2 NS

used to correct Hypernatremia

ISOTONIC

RL - Intra op

NS - ~~Intra op~~ neuro Sx

5% D + 1/4 NS

Plasmalyte.

HYPERTONIC

3% Saline

5% Saline

used to correct hyponatremia

* ↑ ICP

7.5% $NaHCO_3$

5% Dex + 1/2 NS

DNS

CPR

It is done when Pulse = Absent

SEQUENCE - C ⟶ A ⟶ B

COMPRESSION

Adult → **100/min**

Compression & Relp = 30:2

Depth - 2 inches

Children / Infant = **> 100/min**

Comp. : Relp = 30:2 - single person

= 15:2 - double person

Intubation → RR = 8-10/min

Depth : $\frac{1}{3}$rd of A-P Diameter or atleast 1.5 inches

Neonates

Rate of comp. - **90/min**

C:R. = 3:1

Route of neonatal resuscitation = Umbilical vein

DOC for CPR = Adrenaline

IV - 1:10,000

1mg every 3-5 min.

For Anaphylexis - DOC = Adrenaline I.M. 1:1000

For Anaphylactic Shock. DOC = Adrenaline I.V. 1:10,000.

Atropine, Ca, vasopressin → not part of routine CPR

Dextrose - not used in CPR as they worsen outcome of ischaemic neurological injury

M/c Rib # during CPR = 3,4,5 (L) side.

* DRUGS ∠ CAN BE SAFELY GIVEN ~~FR~~ THROUGH TRACHEAL ROUTE

Naloxone
Atropine
Epinephrine
Vasopressin
Lignocaine

Dose = 2-2.5 × I.V. DOSE

* DRUGS CAN'T BE GIVEN THROUGH TRACHEAL

NaHCO3 Noradrenaline
Calcium salts
Bretylium

MODES OF VENTILATION

only Positive pressure ventilation are used

1) CMV [controlled Mech. Ventilation]

- → TV & RR are fixed
- → No spontaneous breathing allowed
- → Minimal work of Breathing
- → ↑ level of sedation + MR reqd.
- → used to ↓ ICP in head injury pts.

2) IMV [Intermittent Mandatory Ventilation]

- → Pt. is allowed to breath spontaneously Between mandatory breaths
- → ↑ level of sedation reqd.
- → No synchronisation bet" patient + ventilatory effort
- → ↑ TV breaths can be delivered Now withdrawn due to volume Injury

3) SIMV [Synchronised Intermittent Mandatory Ventilation]

Pt allowed to breath spontaneously between mandatory breaths ī synchronisation.

mod. level of sedation reqd.
↑ work of breathing

4) PSV [Pressure Support Ventilation]

→ It is used to ↑ TV in spontaneously breathing pts.

→ No mandatory breaths are given.

→ Min. sedation is reqd

5) High Frequency ventilation

3 TYPES

a) High Frequency PPV

Rate = 60 - 120 /min

b) HF Jet ventilation

120 – 180/min

c) HF Oscillation. - 600 - 3000 /min.

USE – Broncho pleural fistula
Tracheo esophageal fistula
Bronchoscopy
Emergency ventilation through cricothyroid
Bronchial Sx.

6) IRV (Inverse Ratio ventilation)

1:3 (N)

Here Inspiration is longer than Exp.

1:1, 2:1 ,, 3:1

7) APRV (Airway Pressure Release ventilation)

→ used for ARDS

⇒ MODES FOR SPONTANEOUS VENTILATION –

IMV

SIMV

PCV

HPV

APRV

⇒ WEANING MODES (gradual withdrawal of ventilatory)

IMV

SIMV

PSV

⇒ PEEP (Positive End Expiratory Pressure)

→ it prevents alveoli from collapsing.

→ it recruits alveoli

Recruitement Pressure = 10–12 cm H_2O.

INDICATIONS OF PEEP

→ Physiological PEEP
→ Pul. oedema
→ ARDS
→ Cardiothoracic Sx

S/E of PEEP

(1) ↓ VR → ↓ BP → (2) ↑ RV afterload
(3) ↑ ICP
(4) ↑ mediastinal pressure
(5) ↑ intrapleural pressure
(6) ↑ Dead space → 2mL/kg (N)

FACTORS

↑ Dead SPACE

1) Upright position
2) Neck extension
3) ↑ age
4) +ve PPV
5) Anticholinergic drug like atropine
6) P. Embolism
7) Emphysema

↓ Dead space

1) Supine Position
2) Neck flexion
3) artificial airway